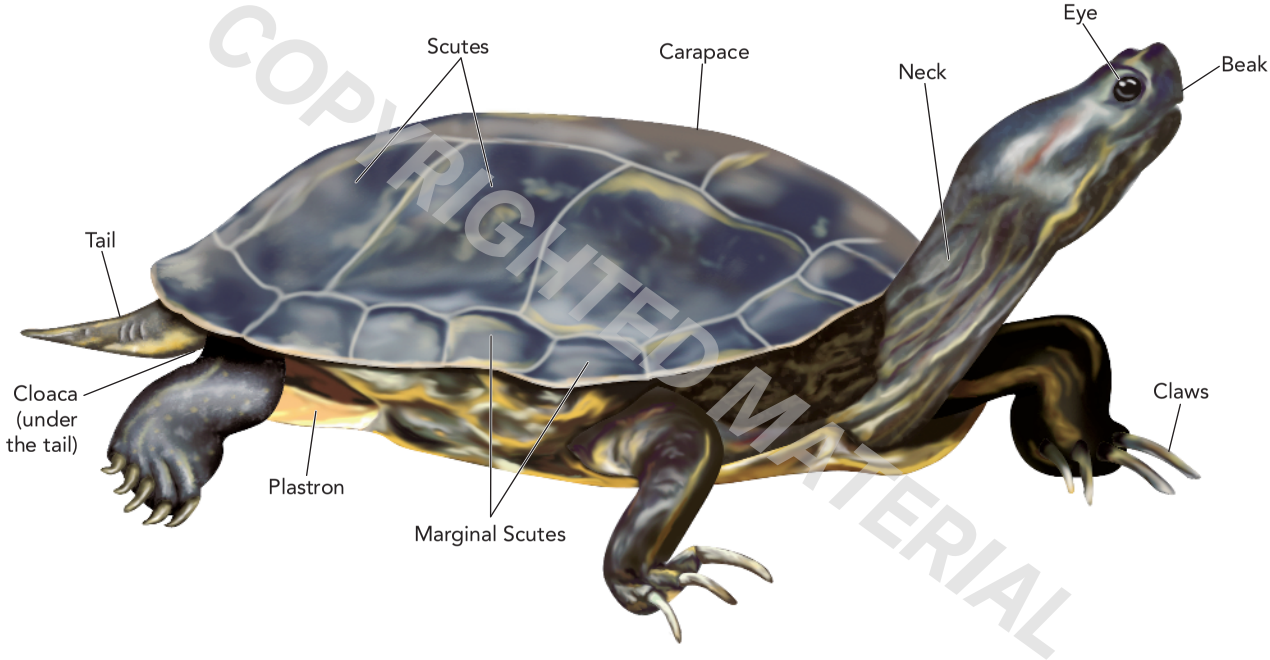
# The Turtle

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## Chapter 1

# What Is a Turtle?

There is perhaps no more easily recognizable animal on earth than a turtle. Although there are lizards who look like snakes and salamanders who look like lizards, no other living creature looks remotely like a turtle. With their calm dispositions and brightly colored shells, turtles have been spared the enmity with which most other reptiles are usually regarded. Unlike lizards and snakes, which are almost universally reviled, turtles are usually considered charming and attractive creatures. Few people, even the most intense reptile haters, are afraid of turtles.

A few decades ago, every convenience store in the country was stocked with tiny, bright green baby turtles, usually found in a shallow water tray complete with a tiny plastic island and a palm tree. Unfortunately, few of the many thousands of people who purchased these little creatures had any real idea how to care for them, and most of them ended up in a watery grave after a few months. This dreadful mortality rate, combined with some exaggerated fears about the spread of disease by turtles, virtually put an end to the turtle pet trade.

Today, however, we have become more knowledgeable about the natural world and the role that various animals play in it—including reptiles—and turtles have once again become popular pets.

This book was written as a guide for the beginning turtle keeper, so new hobbyists can keep their pets happy and healthy. Although keeping turtles and tortoises in captivity is not difficult, there are a few potential problems that turtle keepers must be aware of, and a few rules and procedures that must be followed if these animals are to thrive in captivity.

Our knowledge of how to meet the needs of captive reptiles has expanded enormously in the past few years, and even though this book is aimed primarily at beginners, I hope that it can serve as a useful reference for more experienced turtle keepers, as well.

# The Biology of Turtles and Tortoises

There are about 220 species of turtles living today—less than one-tenth the number of living snakes or lizards. Despite their relative lack of diversity, however, turtles are hardy and adaptable animals, and have moved into a wide variety of habitats, from hot, arid deserts to the open seas.

In size, they range from the tiny Musk turtle, less than 5 inches long, to the huge marine Leatherback, which reaches lengths of over 6 feet and weighs more than half a ton. The largest living land turtle, the Galapagos tortoise, can reach a length of 4½ feet and weigh more than 550 pounds.

All turtles are reptiles, a class of animals characterized by dry scaly skin, a dependence upon external heat sources rather than internal metabolism, and a shelled egg that can be laid on land.

## Ectothermic Animals

Like all other reptiles and amphibians, turtles are ectothermic, meaning they cannot produce their own internal body heat. Such a system of metabolism is sometimes called "cold-blooded," but this is not a very accurate term, since some desert tortoises maintain a body temperature of more than 100 degrees Fahrenheit.

The word *ectothermic* comes from the Latin words for "outside heat," and this is a better description of how the turtle's metabolism functions. In all animals,

*Ectotherms like the turtle cannot produce enough body heat to maintain their temperature at a specific level, so they must get their heat from their environment. Hot desert areas therefore have a wide variety of turtles.*

## Turtle Terminology

Turtles make up the order of reptiles known as Chelonia, which is further divided into two groups: the Cryptodirans (characterized by the ability to pull their heads into their shells by folding their neck vertically) and the Pleurodirans (or side-necked turtles, who retract their heads under the margin of their shells by folding their necks sideways). The vast majority of living turtles belong to the Cryptodiran group.

I have often been asked what the difference is between a turtle, a terrapin, and a tortoise. The word *turtle,* as it's used in everyday language, refers to any member of the Chelonian order—any reptile with a shell. The word *tortoise* is usually used to refer to those Chelonians who live primarily on land and rarely enter water. *Terrapin* usually applies to those turtles who live along streams or ponds and are largely aquatic.

These names have no scientific standing, however; they are simply common names used by nonspecialists. To a biologist, there are no technical distinctions between turtles and terrapins, although usually the term *tortoise* is reserved solely for the members of the Testudidine group of land turtles, and the word *terrapin* most often refers specifically to the Diamondback terrapin of the eastern United States. All the shelled reptiles are members of the order Chelonia, and all Chelonians can correctly be referred to as turtles.

including reptiles, biological processes are controlled by a class of chemicals known as enzymes, and these enzymes work best at rather high temperatures. In "warm-blooded" animals, such as mammals, the heat that is released during metabolism is used to warm the body and maintain the proper temperature for these enzymes, no matter what the environmental temperature might be. A human being, for instance, maintains a body temperature of close to 98.6 degrees Fahrenheit, whether the air temperature is 100 degrees or 50 degrees.

Ectotherms, however, cannot produce enough body heat from their own metabolism to maintain their body temperature at a specific level. Therefore, they would take on the same body temperature as their surroundings. To prevent this, and to maintain a suitable body temperature, reptiles must use external sources of heat to keep their internal temperature high enough. That is why turtles are most often seen basking on logs or rocks in the sun; they are using the heat provided by the sun to raise their body temperature to an acceptable level.

This need to maintain and conserve body heat is one of the most important factors in any turtle's life. In hot environments, such as Latin American and African deserts, it is easy for the turtle to maintain a high body temperature; therefore, semiarid and desert areas have a wide variety of turtles.

Because water can retain heat more effectively than air, aquatic habitats in warm areas also provide the all-important external heat needed by turtles. The largest living turtles are entirely aquatic, and live either in warm, shallow rivers and lakes or in the open seas. Here the ambient temperature is so high that the turtle can afford to develop a large, heavy body—something that would take an unacceptably long time to heat up in cooler areas.

In fact, the large sea turtles, such as Leatherbacks, have such large bodies that they can retain more body heat (which is continuously produced by the action of their swimming muscles) than they lose through their body surface. This enables them to maintain body temperatures that are several degrees higher than the surrounding ocean water.

In cooler, temperate regions, such as North America and Europe, it is more difficult for turtles to stay warm. As a result, turtles from cooler areas are typically smaller and darker in color than tropical turtles (so they can absorb sunlight and heat themselves up faster). In the winter, when short days and colder temperatures make it impossible to maintain the best body temperature, turtles will bury themselves deep in the mud, below the frost line, and hibernate, slowing down virtually all of their body functions. These turtles emerge in the spring when the days grow longer and the temperatures get warmer.

## Chelonian Anatomy

The most obvious characteristic of turtles is, of course, the shell. It varies from the leathery carapace of the Softshell turtle, which contains hardly any bone at all, to the thick casing of the Box turtle, which can make up to one-third of the animal's total body weight. The shell is made from bony plates in the skin that have fused to the rib cage. The internal anatomy of the turtle, particularly the breathing apparatus and the pelvis and shoulder bones (also called the limb girdles), have been heavily modified to accommodate the shell.

## The Eyes

Turtles have excellent vision and can detect motion at a considerable distance. They can also detect the outlines of potential predators, even if the intruder is not moving. Along with their keen sense of smell, turtles use their eyesight as the primary way of finding food. According to most scientists, turtles are able to see in color, and are particularly sensitive to reds and yellows (they can also sense a range of infrared wavelengths that are invisible to humans).

*Many turtles are predators, and their keen eyesight helps them locate and catch their prey.*

Turtle eyes have two large tear ducts (called lachrymal glands), and in some turtles—particularly the marine turtles, who ingest large quantities of salt water with their food—these lachrymal glands are used to excrete excess salt from the body in the form of thick, gel-like "tears."

## The Skull

The turtle skull is heavy and solid, with very thick bones. Turtles lack the holes between skull bones that other reptiles possess. In all the other reptiles—snakes, lizards, and crocodilians—the skull has two distinct holes, called *fossae*, through which the jaw muscles are attached from the temporal area of the skull, just behind the eyes, to the rear portion of the jawbones. Turtles don't have these fossae, and their jaw muscles run along the outside of the skull without passing through any holes, which enables these muscles to expand outward when the jaws are closed.

All turtles lack teeth, and instead have a sharp-edged, horny jaw sheath. Since they cannot chew, turtles must eat by tearing off bite-sized chunks of food using their front claws and their powerful jaws. Predatory turtles, such as Snappers and Big Headed turtles, have sharp, hooklike projections at the tips of their jaws, shaped somewhat like an eagle's beak, to help them hold and tear at prey. Plant eaters have toothlike, serrated jaw margins that enable them to cut and bite through tough plant stems.

## The Tongue

Turtles, like snakes and lizards and many types of mammals, have a structure in the roof of their mouth called the Jacobson's organ, which is used to detect

airborne chemicals. Even though they cannot extend their tongues the way snakes and lizards can, turtles are able to use their thick, fleshy tongues to capture scent particles in the air and transfer these to the Jacobson's organ. The Jacobson's organ is directly connected to the brain by the olfactory nerve. Turtles, thus, have a keen sense of smell, even underwater. To smell underwater, the turtle will open his mouth slightly, drawing in a small amount of water through the nostrils and passing this through the Jacobson's organ before expelling it from the mouth.

In many turtles, the tongue is thick and immovable, and cannot be used for swallowing in the normal manner. These turtles can only swallow underwater, where they can use the rush of water to push food down their throats.

## The Lungs

Because the shell prevents the chest from expanding, turtles must use a special set of muscles in the body to expand and contract the size of their chest cavity by moving some of the internal organs around, pumping air in and out of the lungs like a bellows. The hiss that you often hear when picking up a turtle is not intended as a threat, but is simply the sound made by air being rapidly pushed out of the lungs to make room for the head as it is pulled under the shell.

*Special adaptations in the throat and cloaca enable some turtles to extract oxygen from either air or water, so they can stay under water for long periods.*

In addition, many turtles use a method of breathing called gular pumping, in which the throat is expanded to draw in air, which is then pushed down into the lungs. This throat action is made possible by the large, moveable hyoid bone located in the neck. Some turtles are also capable of using the lining of the throat and cloaca, the cavity into which the digestive, urinary, and reproductive tracts empty, to extract oxygen from either air or water. During hibernation, turtles depend completely upon gular pumping and cloacal breathing for all of their reduced oxygen needs.

## The Heart

Like all reptiles (with the exception of the crocodiles), turtles have a three-chambered heart consisting of two upper chambers and one lower chamber, incompletely divided by a muscular wall. The blood is pumped to the lungs by one of the two upper chambers, known as atria, and returns to the single lower chamber, called the ventricle. Here it mixes with the oxygen-depleted blood returning from the rest of the body. This mixture of oxygen-rich and oxygen-depleted blood is then pumped into the other atrium, where it enters the aortic arches and is distributed throughout the body.

This arrangement mixes unoxygenated blood returning from the body with the oxygenated blood returning from the lungs before it is passed on to the rest of the body. It is an inefficient method of distributing oxygen, and as a result, turtles tire easily and cannot sustain their activity for long periods of time without frequent stops to rest.

## The Shell

The turtle's shell is made up of a top part, called the carapace, and a bottom part, called the plastron. These are connected along the sides of the turtle to form the shell compartment. Both these shell parts are covered with horny plates, called scutes.

### The Scutes

The scutes are made of the protein keratin—the same substance that makes up human fingernails and hair. Scutes are made up of living tissue and contain nerve endings (a turtle can feel it when something is touching his shell). They do not have a large number of pain receptors, but if they are injured or damaged, they have remarkable regenerative powers. The rings that are visible on the scutes of some turtles represent alternate periods of growth and nongrowth, and can sometimes be used to roughly estimate the age of the turtle.

The multiple scutes overlap the underlying bony plates; this strengthens the shell. The scutes are also decorated with colors and patterns that are specific to each species. If a turtle happens to be missing a scute, the bony seams of the carapace are often visible. Damaged scutes are vulnerable to fungal infections.

**CAUTION**

The once common practice of painting the shells of turtles can kill the scutes and infect the underlying bone, causing severe injury.

Commercial tortoiseshell, which was once used in large amounts for combs and decorations, is actually the intricately patterned scutes of sea turtles, usually Green turtles or Loggerheads. The nearly insatiable demand for tortoiseshell led to widespread hunting of these turtles and their near extinction. Today, plastics made to look like tortoiseshell have replaced the real thing in most cases.

## The Carapace

The bony plates that make up the turtle's carapace develop from small, flat bones (sometimes called platelets) in the skin called ossicles or osteoderms, which have become fused to the turtle's rib cage and backbone. The shell is therefore permanently attached to the turtle's skeleton, and a living turtle cannot be removed from his shell.

*The arched design of carapace makes it very strong, and turtles are able to support a lot of weight on their shell. You can clearly see the scutes on these turtles.*

Because of their thickness and their vaulted construction (like the arched roof of a medieval church), turtle carapaces are incredibly strong. A full-grown Galapagos tortoise can easily support the weight of two or three adult humans on his shell. Despite its great strength, however, the carapace is vulnerable to sudden impacts, and can be severely cracked and damaged by a dropped object or a fall.

The Pancake tortoise of Africa is unique among the land tortoises in having large, open spaces in his carapace. These openings, called fontanelles, make the shell flexible, enabling the turtle to escape from predators by retreating deep into a crevice or crack and inflating his lungs to expand the shell and wedge himself tightly in a protective position.

The carapaces of terrestrial tortoises are high and dome-shaped. Since most terrestrial turtles eat plant matter, they must have large stomachs and long intestines to process such low-quality food. Aquatic turtles tend to be more carnivorous and can get by with smaller internal organs. Their shells tend to have a low, flat streamlined shape, which helps reduce drag as the turtle swims about.

## The Plastron

The plastron is the bottom portion of the turtle's shell. It is made up of four pairs of bony plates covered with keratin scutes. The plastron scutes, like those of the carapace, do not coincide with the bones of the plastron.

The plastron is not dragged on the ground when the turtle is walking, but is lifted clear by his legs. Still, the plastron scutes do wear off, and they are constantly being replaced. If the plastron is damaged (by being dragged over a sharp, rocky surface, for instance) the resulting wounds are easily invaded by fungus and can cause serious problems for the turtle.

*If a turtle's plastron is damaged, serious infections can result.*

In some species of turtles, such as Box turtles and Musk turtles, one or two flexible hinges run across the plastron. This enables the turtle to fold his bottom shell and enclose himself tightly within.

### Skin Color

The green skin color found in many aquatic turtles is actually the result of the combination of two separate pigments, yellow and blue, in the lower layers of the skin. Some turtles are born lacking the blue pigment and thus appear yellowish rather than green; these turtles are said to be *leucistic*. An even rarer mutation can cause an absence of the yellow pigment, producing a bright blue turtle.

Occasionally, albino turtles—those with no skin pigment—are born. The Softshell turtles seem especially prone to albinism.

Some turtles have gaps or openings in the bony plates of the plastron and carapace, called fontanelles, which help make the shell lighter. These fontanelles are particularly large in the marine turtles, which must reduce the weight of their bodies to swim efficiently.

## The Limb Girdles

The reptilian pelvis is very different from that of mammals. In mammals, the limbs are underneath the body and the upper bones of the limbs descend in a straight line from the shoulder or hip joints. This enables mammals to carry their body weight efficiently atop their relatively straight legs. In reptiles, however, the joints in the pelvic and shoulder girdles face outward rather than down, forcing the upper limb bones to project out sideways instead of downward. This means that the reptile's feet are located far out to the sides of his body, rather than directly underneath it, as in mammals. Reptiles thus have a characteristic walking pose, with their legs bent out at the elbows and knees, which makes them look as if they are halfway through a push-up.

Although they have the sprawling gait typical of all reptiles, turtles have limb structures that are even more unusual among vertebrates. In most vertebrates, the shoulder and pelvic girdles are on the outside of the rib cage. Because of their shell, turtles have their limb girdles inside their rib cage. The basic effect is that leg mobility is severely limited—hence the proverbially slow turtle.

Despite their reputation for slowness, turtles have strong legs and some species are capable of moving quickly over land for short distances. A number of turtles, particularly those with long legs or smaller plastrons (including Wood and Musk turtles), are excellent climbers, and can easily scale trees or even chain-link fences.

Most turtles are pigeon-toed, and walk with their feet turned inward. In the aquatic turtles, the toes are webbed and the claws are long and sharp. Terrestrial tortoises have short, blunt toes and a somewhat flattened, elephantlike foot designed for digging and burrowing.

## The Cloaca

The cloaca is the single opening under the tail for the turtle's digestive, urinary, and reproductive tracts. Aquatic turtles excrete most of their waste in the form of water-soluble urea, as do mammals. Terrestrial tortoises, who need to conserve their use of water, excrete their waste in the form of dry crystals of uric acid, as do snakes and lizards.

**Did You Know?**

The Box turtle can seal himself so tightly that a knife blade cannot even be inserted into the shell. These turtles are capable of staying closed up for an hour or more, without breathing, until they sense danger has passed.

# Turtle Reproduction

Turtles practice internal fertilization, in which the sperm is introduced directly into the female's cloaca by the male. Turtles have a single penis (male snakes and lizards have a pair of reproductive organs, called hemipenes) with a deep groove running down the middle through which the sperm flows. Female turtles are capable of storing live sperm for up to three years, and can lay viable eggs for several years after a single mating.

Turtle egg shells are formed inside the female by a series of excretions produced by the walls of the oviduct as the developing eggs move down the reproductive tract toward the cloaca. In some species, the eggs are soft and leathery; in most, however, they are hard like bird eggs. The shells of Snapping turtle eggs are so thick that they will often bounce if dropped.

The gestation period varies according to species but is usually between three to four months.

*Turtle mothers do not guard their eggs the way birds do, but they do take care to lay them in spots that are protected from predators.*

Turtle mothers are generally good at securing their eggs. Although no turtle incubates the eggs or guards the young after hatching, most turtles do take particular care in laying them in areas that are environmentally suitable and safe from predators. One exception is the Musk turtle, who has a habit of dropping her eggs right in the open—which is surprising since they lay very few eggs at a time. Apparently, predators don't like Musk turtle eggs very much.